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(54) **BRAKING SYSTEM**

BREMSSYSTEM

SYSTÈME DE FREINAGE

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Description

[0001] The invention relates to a braking control unit for a railway vehicle.

[0002] The current standard communications design in a railway vehicle comprises a CAN bus which enables data to be communicated along the train between devices including the brake control units.

[0003] The CAN communication protocols have proven themselves over several decades of use. It is now conventional to use standard laptop computers to operate diagnostic software and the like, which laptops can be plugged into the CAN bus and be used to communicate with the brake control units. The standard interfaces currently used in Train Management Systems (TMS) such as RS-485, MVB and FIP are regarded as being too slow by users, who want to use faster standards such as Ethernet.

[0004] Ethernet in this context describes the lower-level communications system i.e. the physical layer and simplest data packet transfer. Users require higher-level protocols to be supported that sit on top of Ethernet e.g. Profinet, CIP, TCP, UDP, Web server, maintenance.

[0005] As brake systems are safety critical, it is necessary that any executable software code that runs on the brake control unit and any modules associated with the brake control unit such as wheel slide protection is tested and validated to SIL2 (Safety Integrity Level 2). The problem that this causes is that each new module fitted to the system would need to be validated to SIL2. However, this requires several man years' work and is too expensive and time consuming for most projects.

[0006] GB 2395241 discloses a trailer brake electronic control unit. The ECU has non volatile storage memory means for storing braking related control parameters particular to the vehicle and discretely programmable storage means to carry operating data for one or more auxiliary functions of the vehicle. This is operable to check one or more incoming and outgoing variables and control algorithms against a predefined list such as to safeguard the braking function against error modes. This approach suffers from the drawback that it does not meet users' requirements for new APIs (application programming interface) to support new protocols and interface cards as the functionality in the control unit is limited. EP1084925 discloses a train brake system integrating a computer controlled braking system and an electrically controlled electro-pneumatic braking system by the use of a single control valve.

[0007] The present invention therefore seeks to provide a more flexible brake control unit arrangement.

[0008] According to the invention there is provided a brake control unit for a railway vehicle having first and second cores, wherein the first core is responsible for brake control functions and the second core is responsible for communications, the arrangement further comprising a switch adapted to control communication between the second core and a communication bus on the

railway vehicle so as to safeguard the braking function of the first core, wherein the second core only has write access to the communication bus when enabled by the first core, which first core determines whether the system is in a defined safe state to thereby safeguard the braking function.

[0009] In the solution according to the invention, the main 'Control' processor provides all standard Brake Control Algorithm processing as before, but the TMS communications are moved to a second 'Communications' processor. The Communications processor is SIL0 compliant, which reduces the requirement for testing.

[0010] Moreover all communications CPU performance is provided by the Communications processor, allowing more performance for the control processor for Brake Control Algorithms.

[0011] An exemplary embodiment of the invention will now be described in greater detail with reference to the drawings in which:

Fig. 1 shows schematically train wide network architecture

Fig. 2 shows schematically the architecture according to the invention

[0012] Figure 1 shows schematically a train wide network architecture showing a CAN bus 1. A brake control unit 2 comprising a core CPU 3 is connected to the bus 1. The brake control unit 2 may be provided with one or more modules such as the exemplary RIO (4) and RBX (5) modules, which modules are arranged in series with the brake control unit 2. The brake control unit core CPU 3 is validated to SIL 2 standard. The RIO and RBX modules must also be validated to SIL 2 standard.

[0013] A laptop 6 running standard diagnostic software is also connected to the bus 1 via a USB-CAN bus dongle 7. This arrangement allows the laptop to communicate safely with the brake control unit 2.

[0014] Figure 2 shows schematically the architecture of the train network according to the invention showing a CAN bus 10. A brake control unit 11 comprising first (12) and second cores (13) is connected to the bus 10. The brake control unit 11 may be provided with one or more modules such as the exemplary RIO (14) and RBX (15) modules, which modules are arranged in series with the brake control unit 11. The can bus 10 will typically be a dual CAN bus having a level 1 brake bus and a level 2 train bus.

[0015] The brake control unit core 12 is responsible for the braking function and is connected to the bus. The core 13 is responsible for communication functions and is connected to the bus 1 by way of a CAN switch 16, the operation of which switch 16 is controlled by the brake control unit core 12. The communication core 13 can receive data directly from the CAN bus but cannot write data to the CAN bus unless permitted to do so by the brake control unit core 12. The communication core 13 comprises a web server and enables web based appli-

cations to be installed and run on the core. The communication core 13 and any applications or software running on the core 13 need not be validated to SIL2. Typically the communications core will only write to the bus when there is a software update or maintenance to the brake system, which will require communication along the brakes layer of the bus. The communications core 13 can monitor the data on the brake databus and this can either be logged in the core or sent back to the driver. The separation of the monitoring function from the brake control function will also result in a performance enhancement to the brake core 12 as there is no extra loading. The arrangement also eases interaction with different level 2 buses.

[0016] The SILO processor only has write access to the Level-1 network when enabled by the SIL2 processor, which determines whether the system is in a defined 'safe state' so as to safeguard the braking function.

[0017] The bus is provided with several levels of security, with communication on level 1 being the most secure as this is used for safety critical data such as that relating to the operation of the railway vehicle brakes. The communication core 13 can receive data directly from the CAN bus but cannot write data to the CAN bus unless permitted to do so by the brake control unit core 12 when the core 12 has determined that the brake system is in a safe state. Typically such a safe state can include when the vehicle is stationary but it may include further variables such as ensuring that the emergency brake is applied or ensuring that the vehicle has been stationary for a predetermined period of time.

Claims

1. A brake control unit (11) for a railway vehicle having first (12) and second (13) cores, wherein the first core (11) is responsible for brake control functions and the second core (12) is responsible for communications, the arrangement further comprising a switch (16) adapted to control communication between the second core and a communication bus on the railway vehicle so as to safeguard the braking function of the first core (12), wherein the second core (13) only has write access to the communication bus when enabled by the first core, which first core (12) determines whether the system is in a defined safe state to thereby safeguard the braking function.
2. A brake control unit according to Claim 1, wherein the first core has at least a safety integrity level SIL2 and the second core has a lower safety integrity level than the first core.
3. A brake control unit according to Claim 2, wherein the second core has a safety integrity level SILO.
4. A brake control unit according to any one of Claims

1 to 3, wherein the first core determines whether the system is in a defined state by determining if the vehicle is stationary.

5. A brake control unit according to any one of Claims 1 to 4, the second core is adapted to monitor the data on the bus and either log the data in the core or send the data back to the train via a second bus.

Patentansprüche

1. Bremssteuereinheit (11) für ein Eisenbahnfahrzeug, mit einem ersten (12) und einem zweiten (13) Kern, wobei der erste Kern (11) für Bremssteuerfunktionen und der zweite Kern (12) für Kommunikation zuständig ist, die Anordnung weiter umfassend einen Schalter (16), der zur Steuerung der Kommunikation zwischen dem zweiten Kern und einem Kommunikationsbus am Eisenbahnfahrzeug ausgelegt ist, um die Bremsfunktion des ersten Kernels (12) sicherzustellen, wobei der zweite Kern (13) nur bei Freigabe durch den ersten Kern Schreibzugriff zum Kommunikationsbus hat und der erste Kern (12) bestimmt, ob das System in einem definierten sicheren Zustand ist, wodurch die Bremsfunktion sichergestellt wird.
2. Bremssteuereinheit nach Anspruch 1, wobei der erste Kern mindestens ein Sicherheitsintegritätslevel SIL2 hat und der zweite Kern ein niedrigeres Sicherheitsintegritätslevel hat als der erste Kern.
3. Bremssteuereinheit nach Anspruch 2, wobei der zweite Kern ein Sicherheitsintegritätslevel SILO hat.
4. Bremssteuereinheit nach einem der Ansprüche 1 bis 3, wobei der erste Kern bestimmt, ob das System in einem definierten sicheren Zustand ist, indem er feststellt, ob das Fahrzeug stillsteht.
5. Bremssteuereinheit nach einem der Ansprüche 1 bis 4, wobei der zweite Kern zur Überwachung der Daten am Bus und entweder zum Registrieren der Daten im Kern oder zum Zurücksenden der Daten zum Zug über einen zweiten Bus ausgelegt ist.

Revendications

1. Unité de commande de frein (1) pour un véhicule de chemin de fer ayant une première partie centrale (12) et une seconde partie centrale (13), la première partie centrale (12) prend en charge les fonctions de commande de frein et la seconde partie centrale (13) prend en charge les communications, le système comprenant en outre un commutateur (16) conçu pour commander la communication entre la seconde

partie centrale et un omnibus de communication dans le véhicule de chemin de fer pour sauvegarder la fonction de freinage de la première partie centrale (12), la seconde partie centrale (13) possède uniquement un accès d'écriture à l'omnibus de communication lorsqu'elle est activée par la première partie centrale, ladite première partie centrale (12) détermine si le système se trouve dans un état de sécurité défini pour ainsi sauvegarder la fonction de freinage.

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2. Unité de commande de frein selon la revendication 1, la première partie centrale possède au moins un niveau d'intégrité de sécurité SIL2 et la seconde partie centrale possède un niveau d'intégrité de sécurité inférieur à la première partie centrale.

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3. Unité de commande de frein selon la revendication 2, la seconde partie de frein possède un niveau d'intégrité de sécurité SIL0.

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4. Unité de commande de frein selon l'une quelconque des revendications 1 à 3, la première partie centrale déterminant si le système se trouve dans un état défini par détermination si le véhicule est stationnaire.

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5. Unité de commande de frein selon l'une quelconque des revendications 1 à 4, la seconde partie étant conçue pour surveiller les données sur l'omnibus et soit pour journaliser les données dans la partie centrale soit pour retourner les données au train par l'intermédiaire de l'omnibus.

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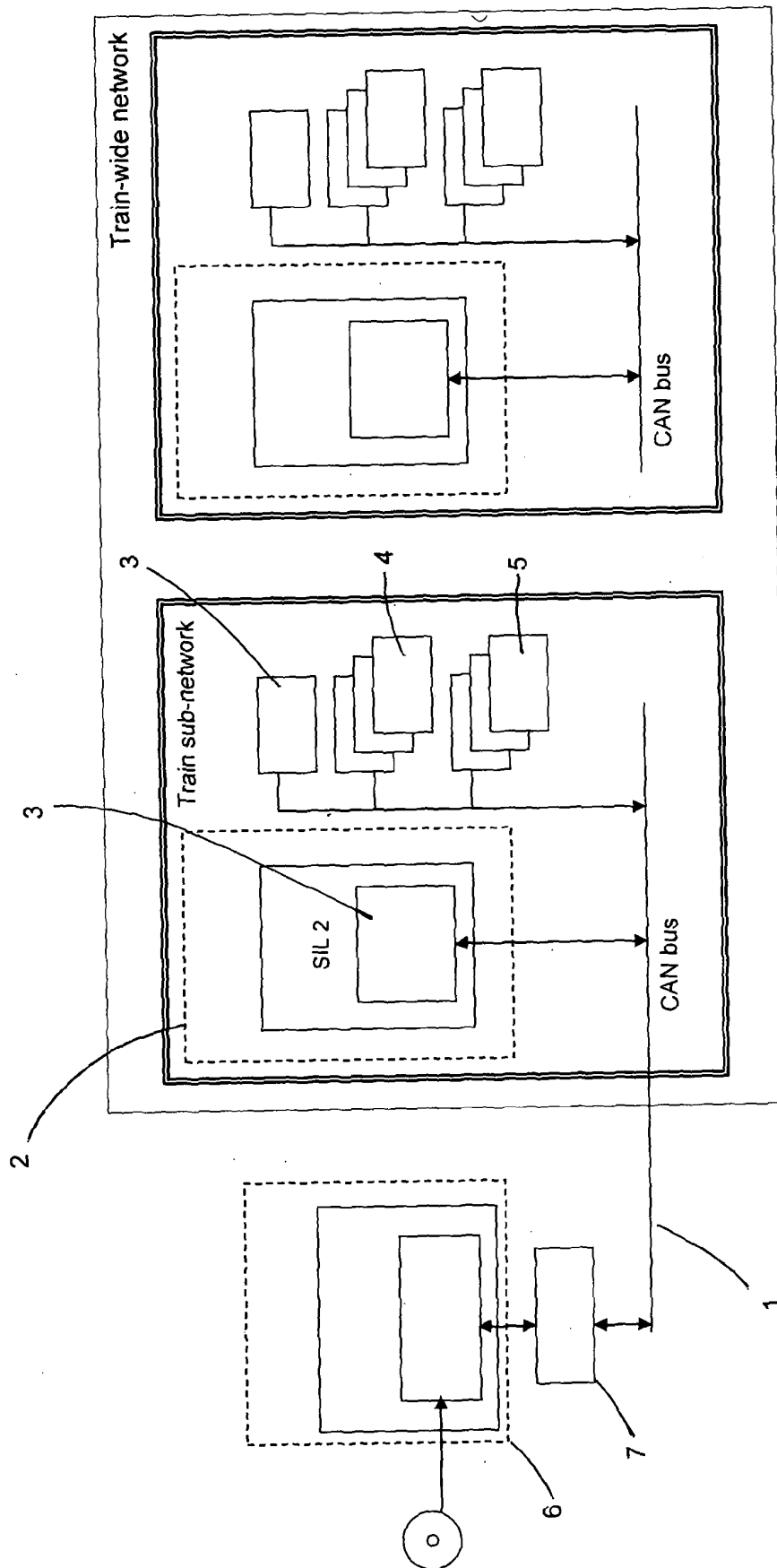


Fig. 1

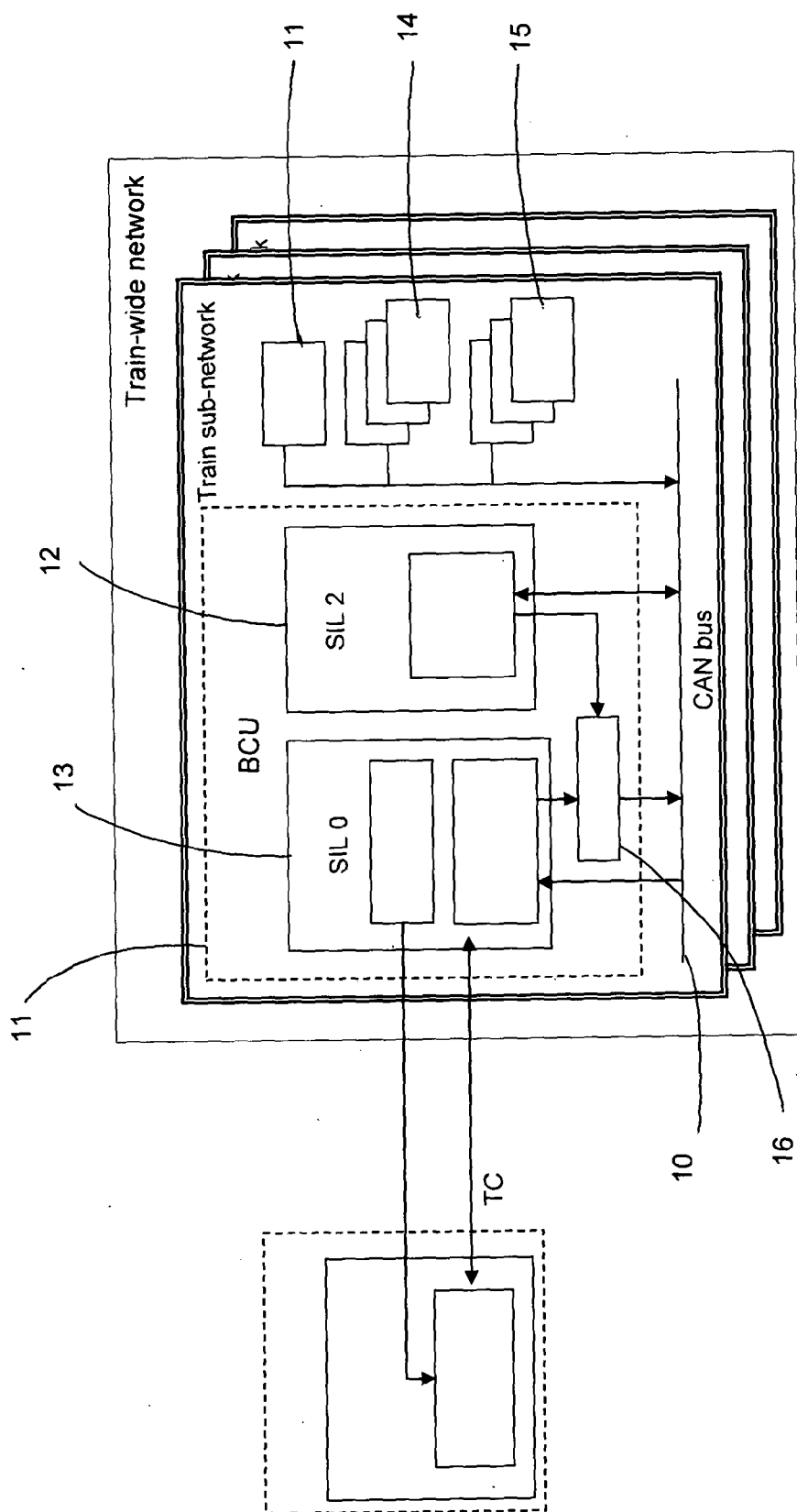


Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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